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PRODUCTION AND USES OF SORBITOL

by Lorand Borzodi

The tremendous expansion of the machine and construction industries has placed ever-increasing demands on the varnish and lacquer industry, especially in regard to synthetic resins. Glycerin is one of the basic substances of synthetic resins and much thought has been devoted to the problem of finding a technically adequate substitute for glycerin. However, this problem does not affect the lacquer industry alone, but also other industries using glycerin.

According to experiments conducted over the past few years, sorbitol proved in many cases to be a suitable substitute for glycerin. Sorbitol may be produced by catalytic reduction from dextrose using metallic magnesium at a temperature of 95 - 105 C° and 60 - 70 atmospheres pressure. Another production method is organic electrolytic reduction.

Sorbitol is a hexahydroxy alcohol. In its pure form it is a pleasant and sweet-tasting white crystalline powder. It dissolves exceptionally well in methyl and ethyl alcohol, in acetic acid, and in phenol, but is practically insoluble in other organic solvents. The dissolving of sorbitol is an endothermic process (-26.5 calories per kilogram). In its crystalline state it is very susceptible to molds, while dissolved in distilled water it is stable. The decomposition of sorbitol is brought about by weak acids and bases and even by the air's carbon dioxide content.

The possible uses of sorbitol are clearly indicated by the characteristics it shares with polyhydroxy alcohols, and further by its similarity to glycerin. Nevertheless, sorbitol cannot always be substituted for glycerin. On the other hand, due to its structure, sorbitol may be used independently; Thus, for example, one of the cheapest synthetization methods of Vitamin C is based on sorbitol.

In general, the employment of sorbitol is determined by its moisture-preserving effect. As a humectant, a sorbitol solution surpasses glycerin, and retards a quick change in moisture content better than do other polyhydroxy alcohols. The sorbitol solution's viscosity is the greatest of all

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polyhydroxy alcohols.

Loss of moisture, causing shrinkage and hardening, has always been one of the difficult problems in the use of adhesives. In general practice, this loss is reducible through the use of glycerin; however, it has been discovered that sorbitol not only duplicates, but even surpasses the action of glycerin.

As a moistener, sorbitol may be used in the following fields: in the synthetic industry (for example, in the production of water-soluble resins), in the pharmaceutical industry, in the manufacture of industrial substitutes, in the tobacco and cosmetics industries, and in the production of adhesive substances.

The applications of sorbitol in the cosmetics industry are the same as those of glycerin. Laboratory experiments have proved that the sorbitol solution does not harm the skin even when used in a concentration greater than that of other polyhydroxy alcohols. Mixed with the basic component of powder, sorbitol provides a greasy texture for the preparation (liquid powder) this probably refers to colored make-up bases. In other cosmetic preparations, such as hand and face creams, the use of sorbitol assures the moisture content needed by the skin.

As a conditioner, sorbitol has its uses in the processing moistening of leather. Even if used in a slight concentration, it imparts an unusual softness to the leather. If handled correctly, it does not become mouldy and does not evaporate. Sorbitol has been used with excellent results in the greasing process, without damaging the leather. Sorbitol has also been added to the lubricants used to preserve the finished leather, and greatly increases their softening action.

Aside from its function as a humectant, sorbitol's chief use is in the varnish and lacquer industry, where it is widely employed in the manufacture of synthetic siccatives, alkyl resins modified with oil, resin esters, and softening agents. The addition of sorbitol greatly increases the quality of the products and improves especially their adhesive power.

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Synthetic drying oils and their derivatives produced from sorbitol and sebacic acid, are superior to similar products produced from natural oils, because they dry quicker and possess greater toughness and viscosity. Although these synthetic oils have a somewhat greater acid content than natural oils, there is no difference between the two groups as to color absorption. Moreover, synthetic oils lend themselves to a wider field of application than natural oils.

However, synthetic oils have to be watched carefully during esterification, since the danger of caramelization is present. Therefore, they should not be brought in direct contact with the source of heat, but have to be processed on oil-baths, etc. Frequent stirring is imperative to prevent partial overheating.

Quick-drying sorbitol esters made from acids of the cheapest oil (refined tall oil) are of great commercial value. The alkyl resins prepared with a sorbitol-glycerin combination are in many ways superior to those prepared with glycerin only. Greater hardness, flexibility, and durability can be achieved in products manufactured with alkyl resins containing the sorbitol-glycerin combination.

One of the problems of the varnish and lacquer industry is coating of food containers, for which a colorless, tasteless, odorless and acid-resistant coating is needed. From sorbitol modified hard resins of excellent quality can be produced, which lend themselves very well to the above purpose. These hard resins also have the interesting and valuable property of tolerating very well certain film-forming materials such as nitrocellulose, etc.

Sorbitol is also used in the pharmaceutical industry. Its use in the synthesis of Vitamin C has been mentioned. Because of its relatively great chemical stability, sorbitol is used in some pharmaceuticals as a sugar substitute. This is of particular importance in pharmaceuticals for diabetics. Sorbitol can be used as a sugar substitute in diabetic diets, since it has been discovered that it can be utilized as nourishment by the human body.

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Sorbitol itself does not influence the secretion of insulin and can, therefore, not be regarded as a medicine when used as a sugar substitute. However, since its caloric value almost equals that of glucose (100 grams sorbitol have 390 calories), it can be used as a glucose substitute. The human body is capable of resorbing 89 per cent of 100 grams of sorbitol, and only the remaining 11 per cent leave the body unused. Since the transformation of sorbitol into glucose is extremely slow, it does not overburden the Langerhans islands. Consequently, hyperglycemia cannot be observed in healthy or slightly diabetic persons treated with sorbitol.

The derivatives of sorbitol also have industrial value. Its organic esters, especially laurin ricinoleate, may be used with saturated and unsaturated fatty acids as surface-active materials. The most important of its inorganic esters, sorbitol hexanitrate, may be used in the manufacture of modern explosives. The pure sorbitol hexanitrate is a solid with approximately 18.5 per cent nitrogen content; its melting point is 54 C°. However, in practice a liquid mixture of products of varying nitrate content is obtained. Under certain conditions this mixture can be used very economically for the production of explosives, primarily for industrial purposes.

When sorbitol is produced by electrolysis, an isomer is created from which mannitol hexanitrate is derived. This hexanitrate is a well-known high explosive, which is also widely used as the primer in percussion caps.

There are several methods of making ether from sorbitol. Depending on the method, various ethers - ranging from monoether to pentaether - can be produced. These sorbitol ethers are stable, their vapor pressure is low, and they are readily compatible with cellulose derivatives. Therefore, they are widely used as softening agents for films and lacquers.

These are, briefly, the practical uses of sorbitol. The chemical's full possibilities are by far not exhausted, since sorbitol can be used everywhere where glycerin is applied.

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COMMENTS ON THE FOREGOING ARTICLE

by Andor Lukacs

Sorbitol and its derivatives are used widely in the pharmaceutical and cosmetic industries. Sorbitol is successfully used as a glycerin substitute; in fact, in many cases one cannot speak of substitution because sorbitol shows many advantages over glycerin. For example, in the preparation of creams, especially with the O/W type emulsion, the use of sorbitol greatly delays surface drying. The cementification of toothpastes, which frequently occurs when glycerin is used, is checked by sorbitol.

Summarizing its advantages, sorbitol, or more accurately, sorbitol syrup, is more viscous and gives more body to the preparations than does glycerin. The sticky feeling imparted by the latter is also lessened. Furthermore, sorbitol syrup does not irritate the skin, is less hygroscopic than glycerin, and permits better distribution of the emulsion.

As a glycerin substitute, sorbitol is used as an aqueous syrup which can be manufactured cheaply in the following manner. Invert-sugar syrup is completely hydrogenated with a Raney nickel catalyst in the presence of metallic magnesium at a temperature of 80 - 90° centigrade at 20 - 50 atmospheres pressure. The resulting hexitol solution is evaporated to 26 - 27° Baume. These solutions are stable and crystallize only when cooled, or when they have retained some sugar.

Sorbitol syrup is also a good softening agent for gallalit and recovered cellulose. Just like glycerin, the syrup is an anti-freeze.

The bismuth complexes of sorbitol (mannitol) have been found effective in the treatment of syphilis.

Through dehydration, sorbitan (Arlitan) is gained from sorbitol. The sebacic acid esters of sorbitan resemble the esters of sorbitol and, like them, are valuable emulsifiers.

Sorbitol-berat is an excellent water-soluble resin.

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by Alajos Jokai

As far as I know, the experiments conducted with sorbitol in relation to the lacquer and varnish industry are past the laboratory stage, and the product will soon be introduced in the market.

One of the components of synthetic siccatives raises the acid content of finished siccatives. This factor limits their use in connection with basic pigments (white lead, white zinc), since metal soaps causing thickening of the mixture are formed if the acid content surpasses a certain percentage. Therefore, one of the purposes of the synthesis of siccatives by means of sorbitol is to reduce the acid content to the minimum.

In the synthesis of alkyl resins prepared with sorbitol, sorbitol may act as a glycerin substitute in phthalic-acid glycerin esters and also in the synthetic siccative components of alkyl resins.

Sorbitol must not contain dextrose, because even an infinitesimal amount of dextrose may cause caramelization, especially during the synthesis of alkyl resins.

By Tivadar Lorentei

The best method for producing sorbitol is catalytic hydrogenation. The catalyst, Raney nickel, is mixed with metallic magnesium, which considerably lessens the reaction time. Iron impurities expedite the caramelization of sorbitol. When in a syrup state (1 - 2 per cent of moisture content), sorbitol, if kept at room temperature, does not crystallize for several days, but only becomes stiff. However, with the application of a little pressure, crystallization starts within a few minutes, accompanied by a perceptible rise in temperature.

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